SEQUENCE LISTING

<110> Conkling, Mark

<120> MODIFYING NICOTINE AND NITROSAMINE
LEVELS IN TOBACCO

<130> VTOB.033C1

<150> 60/297,154
<151> 2001-06-08

<150> PCTUS02/18040
<151> 2002-06-06

<160> 58

<170> FastSEQ for Windows Version 4.0

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<213> Nicotiana tabacum

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<210> 2
<211> 351
<212> PRT
<213> Nicotiana tabacum

<400> 2

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            20                  25                  30
Thr Arg Val Glu Ser Leu Glu Val Lys Pro Pro Ala His Pro Thr Tyr
        35                  40                  45
Asp Leu Lys Glu Val Met Lys Leu Ala Leu Ser Glu Asp Ala Gly Asn
    50                  55                  60
Leu Gly Asp Val Thr Cys Lys Ala Thr Ile Pro Leu Asp Met Glu Ser
65                  70                  75                  80
Asp Ala His Phe Leu Ala Lys Glu Asp Gly Ile Ile Ala Gly Ile Ala
                85                  90                  95
Leu Ala Glu Met Ile Phe Ala Glu Val Asp Pro Ser Leu Lys Val Glu
            100                 105                 110
Trp Tyr Val Asn Asp Gly Asp Lys Val His Lys Gly Leu Lys Phe Gly
        115                 120                 125
Lys Val Gln Gly Asn Ala Tyr Asn Ile Val Ile Ala Glu Arg Val Val
    130                 135                 140
Leu Asn Phe Met Gln Arg Met Ser Gly Ile Ala Thr Leu Thr Lys Glu
145                 150                 155                 160
Met Ala Asp Ala Ala His Pro Ala Tyr Ile Leu Glu Thr Arg Lys Thr
                165                 170                 175
Ala Pro Gly Leu Arg Leu Val Asp Lys Trp Ala Val Leu Ile Gly Gly
            180                 185                 190
Gly Lys Asn His Arg Met Gly Leu Phe Asp Met Val Met Ile Lys Asp
        195                 200                 205
Asn His Ile Ser Ala Ala Gly Gly Val Gly Lys Ala Leu Lys Ser Val
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Asp Gln Tyr Leu Glu Gln Asn Lys Leu Gln Ile Gly Val Glu Val Glu
225                 230                 235                 240
Thr Arg Thr Ile Glu Glu Val Arg Glu Val Leu Asp Tyr Ala Ser Gln
                245                 250                 255
Thr Lys Thr Ser Leu Thr Arg Ile Met Leu Asp Asn Met Val Val Pro
            260                 265                 270
Leu Ser Asn Gly Asp Ile Asp Val Ser Met Leu Lys Glu Ala Val Glu
        275                 280                 285
Leu Ile Asn Gly Arg Phe Asp Thr Glu Ala Ser Gly Asn Val Thr Leu
    290                 295                 300
Glu Thr Val His Lys Ile Gly Gln Thr Gly Val Thr Tyr Ile Ser Ser
305                 310                 315                 320
Gly Ala Leu Thr His Ser Val Lys Ala Leu Asp Ile Ser Leu Lys Ile
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<210> 3
<211> 1053
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<213> Nicotiana tabacum

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<210> 4
<211> 50
<212> PRT
<213> Nicotiana tabacum

<400> 4
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Thr Ala Pro Arg Leu Val Val Lys Met Ser Ala Ile Ala Thr Lys Asn
            20   25   30
Thr Arg Val Glu Ser Leu Glu Val Lys Pro Pro Ala His Pro Thr Tyr
        35   40   45
Asp Leu
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<210> 5
<211> 13
<212> PRT
<213> Rhodospirillum rubrum

<400> 5
Arg Pro Asn His Pro Val Ala Ala Leu Ser Phe Ala Ile
 1   5   10

<210> 6
<211> 10
<212> PRT
<213> Mycobacterium lepre

<400> 6
Leu Ser Asp Cys Glu Phe Asp Ala Ala Arg
 1   5   10

<210> 7
<211> 22
<212> PRT
<213> Salmonella typhimurium

<400> 7
Pro Pro Arg Arg Asn Pro Asp Asp Arg Asp Ala Leu Leu Arg Ile Asn

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 1               5                  10                  15
Leu Asp Ile Ala Ala Val
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<210> 8
<211> 22
<212> PRT
<213> Escherichia coli

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Pro Pro Arg Arg Asn Pro Asp Thr Arg Asp Glu Leu Leu Arg Ile Asn
 1               5                  10                  15
Leu Asp Ile Gly Ala Val
            20
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<210> 9
<211> 25
<212> PRT
<213> Homo sapiens

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<400> 9
Asp Glu Gly Ala Leu Leu Leu Pro Pro Val Thr Leu Ala Ala Leu Val
 1               5                  10                  15
Asp Ser Trp Leu Arg Glu Asp Cys Gly
            20                  25
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<210> 10
<211> 26
<212> PRT
<213> Saccharomyces cerevisiae

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<400> 10
Pro Val Tyr Glu His Leu Leu Pro Val Asn Gly Ala Trp Arg Gln Asp
 1               5                  10                  15
Val Thr Asn Trp Leu Ser Glu Asp Val Ser
            20                  25
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<210> 11
<211> 46
<212> PRT
<213> Nicotiana tabacum

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Lys Glu Val Met Lys Leu Ala Leu Ser Glu Asp Ala Gly Asn Leu Gly
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Asp Val Thr Cys Lys Ala Thr Ile Pro Leu Asp Met Glu Ser Asp Ala
            20                  25                  30
His Phe Leu Ala Lys Glu Asp Gly Ile Ile Ala Gly Ile Ala
        35                  40                  45
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<210> 12
<211> 29

<212> PRT
<213> Rhodospirillum rubrum

<400> 12
Asp Ala Val Arg Arg Ala Leu Arg Ala Ile Ser Thr Ala Ala Thr Arg
 1   5   10   15
Ala His Arg Phe Val Arg Gln Pro Leu Leu Gly Cys Ala
            20   25

<210> 13
<211> 38
<212> PRT
<213> Mycobacterium lepre

<400> 13
Asp Thr Ile Arg Arg His Leu Arg Tyr Gly Leu Ile Thr Gln Val Ala
 1   5   10   15
Gly Thr Val Val Thr Gly Ser Met Val Pro Arg Pro Val Ile Ala Gly
            20   25   30
Val Asp Val Ala Leu Leu
        35

<210> 14
<211> 38
<212> PRT
<213> Nicotiana tabacum

<400> 14
Ala Gln Ala Leu Arg Glu Asp Leu Gly Gly Glu Val Asp Ala Gly Asn
 1   5   10   15
Ile Ala Gln Leu Leu Ala Thr Gln Ala His Thr Val Ile Thr Arg Asp
            20   25   30
Val Phe Cys Gly Lys Arg
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<210> 15
<211> 37
<212> PRT
<213> Salmonella typhimurium

<400> 15
Ala Gln Ala Leu Arg Glu Asp Leu Gly Gly Thr Val Asp Ala Asn Asn
 1   5   10   15
Ile Ala Leu Leu Glu Asn Ser Arg His Thr Val Ile Thr Arg Asn Val
            20   25   30
Phe Cys Gly Lys Arg
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<210> 16
<211> 27
<212> PRT
<213> Homo sapiens

<400> 16
Leu Asn Tyr Ala Ala Leu Val Ser Gly Ala Gly Pro Gln Ala Ala Leu
 1   5   10   15
Trp Ala Lys Ser Pro Val Leu Ala Gly Gln Pro
            20   25

<210> 17
<211> 28
<212> PRT
<213> Sacharomyces cerevisiae

<400> 17
Phe Asp Phe Gly Gly Tyr Val Val Gly Ser Asp Leu Lys Glu Ala Asn
 1   5   10   15
Leu Tyr Cys Lys Gln Asp Met Leu Cys Gly Val Pro
            20   25

<210> 18
<211> 43
<212> PRT
<213> Nicotiana tabacum

<400> 18
Leu Ala Glu Met Ile Phe Ala Glu Val Asp Pro Ser Leu Lys Val Glu
 1   5   10   15
Trp Tyr Val Asn Asp Gly Asp Lys Val His Lys Gly Leu Lys Phe Gly
            20   25   30
Lys Val Gln Gly Asn Ala Tyr Asn Ile Val Ile
        35   40

<210> 19
<211> 34
<212> PRT
<213> Rhodospirillum rubrum

<400> 19
Arg Ser Ala Phe Ala Leu Leu Asp Asp Thr Val Thr Phe Thr Thr Pro
 1   5   10   15
Leu Glu Ala Glu Ile Ala Ala Gln Thr Val Ala Glu Ala Ala Arg Thr
            20   25   30
Leu Ala

<210> 20
<211> 35
<212> PRT
<213> Mycobacterium lepre

<400> 20
Val Leu Asp Val Phe Gly Val Asp Gly Tyr Arg Val Leu Tyr Arg Glu
 1   5   10   15
Ala Arg Leu Gln Ser Gln Pro Leu Leu Thr Val Gln Ala Ala Arg Gly
            20   25   30

Leu Leu Thr
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<210> 21
<211> 36
<212> PRT
<213> Salmonella typhimurium

<400> 21
Trp Val Glu Val Phe Ile Gln Leu Ala Gly Asp Asp Val Arg Leu Thr
1 5 10 15
His Asp Ala Ile Ala Asn Gln Thr Val Phe Glu Leu Asn Pro Ala Arg
20 25 30
Val Leu Leu Thr
35

<210> 22
<211> 37
<212> PRT
<213> Escherichia coli

<400> 22
Trp Val Glu Val Phe Ile Gln Leu Ala Gly Asp Asp Val Thr Ile Ile
1 5 10 15
His Asp Val Ile Asn Ala Asn Gln Ser Leu Phe Glu Leu Glu Pro Ser
20 25 30
Arg Val Leu Leu Thr
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<210> 23
<211> 36
<212> PRT
<213> Homo sapiens

<400> 23
Phe Phe Asp Ala Ile Phe Thr Gln Leu Asn Cys Gln Val Ser Phe Leu
1 5 10 15
Pro Glu Ser Leu Val Pro Val Ala Arg Val Ala Glu Val Arg Pro His
20 25 30
Asp Leu Leu Leu
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<210> 24
<211> 40
<212> PRT
<213> Saccharomyces cerevisiae

<400> 24
Phe Ala Trp Val Phe Asn Gln Cys Glu Leu Gln Val Glu Leu Phe Lys
1 5 10 15
Glu Ser Phe Leu Glu Pro Ser Lys Asn Asp Ser Gly Lys Ile Val Val
20 25 30
Ala Lys Ile Thr Pro Lys Leu Leu

35 40

<210> 25
<211> 46
<212> PRT
<213> Nicotiana tabacum

<400> 25
Ala Glu Arg Val Val Leu Asn Phe Met Gln Arg Met Ser Gly Ile Ala
1 5 10 15
Thr Leu Thr Lys Glu Met Ala Asp Ala Ala His Pro Ala Tyr Ile Leu
20 25 30
Glu Thr Arg Lys Thr Ala Pro Gly Leu Arg Leu Val Asp Lys
35 40 45

<210> 26
<211> 24
<212> PRT
<213> Rhodospirillum rubrum

<400> 26
Thr Ala Leu Gly His Leu Arg Arg Arg Phe Gly Ala Ile His Thr Arg
1 5 10 15
Arg Leu Thr Cys Thr Gly Leu Glu
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<210> 27
<211> 25
<212> PRT
<213> Mycobacterium lepre

<400> 27
Thr Met Val Cys His Met Val Val Ala Trp Val Ala Val Arg Gly Thr
1 5 10 15
Lys Lys Ile Arg Asp Leu Ala Leu Gln
20 25

<210> 28
<211> 29
<212> PRT
<213> Salmonella typhimurium

<400> 28
Gly Thr Ala Val Thr Leu Val Ala Ser Glu Val Arg Arg Tyr Val Gly
1 5 10 15
Leu Leu Gly Thr Gln Thr Gln Leu Asp Leu Thr Ala Leu
20 25

<210> 29
<211> 31
<212> PRT
<213> Escherichia coli

<400> 29
Gly Pro Thr Ala Val Thr Leu Val Ala Ser Lys Val Arg His Tyr Val
 1   5   10   15
Glu Leu Leu Glu Gly Thr Asn Thr Gln Leu Asp Leu Ser Ala Leu
            20   25   30

<210> 30
<211> 31
<212> PRT
<213> Homo sapiens

<400> 30
Gly Ala Thr Leu Ala Arg Cys Ser Ala Ala Ala Ala Ala Val Glu Ala
 1   5   10   15
Ala Arg Gly Ala Gly Trp Thr Gly His Val Ala Gly Thr Phe Glu
            20   25   30

<210> 31
<211> 32
<212> PRT
<213> Saccharomyces cerevisiae

<400> 31
Thr Ala Ile Leu Ser Arg Ser Thr Ala Ser His Lys Ile Ile Ser Leu
 1   5   10   15
Ala Arg Ser Thr Gly Tyr Lys Gly Thr Ile Ala Gly Thr Arg Leu Glu
            20   25   30

<210> 32
<211> 50
<212> PRT
<213> Nicotiana tabacum

<400> 32
Trp Ala Val Leu Ile Gly Gly Gly Lys Asn His Arg Met Gly Leu Phe
 1   5   10   15
Asp Met Val Met Ile Lys Asp Asn His Ile Ser Ala Ala Gly Gly Val
            20   25   30
Gly Lys Ala Leu Lys Ser Val Asp Gln Tyr Leu Glu Gln Asn Lys Leu
        35   40   45
Gln Ile
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<210> 33
<211> 26
<212> PRT
<213> Rhodospirillum rubrum

<400> 33
Tyr Arg Cys Ser Phe Asp Ala Leu Ala Val Ala Ser Ala Ser Arg Ala
 1   5   10   15
Arg Ala Gly Val Gly His Met Val Arg Ile

20 25

<210> 34
<211> 26
<212> PRT
<213> Mycobacterium lepre

<400> 34
Tyr Arg Val Val Leu Gly Thr Ala Leu Val Ala Val Ser Val Asp Arg
1 5 10 15
Ala Arg Ala Ala Ala Pro Glu Leu Pro Cys
20 25

<210> 35
<211> 25
<212> PRT
<213> Salmonella typhimurium

<400> 35
Tyr Cys Ala Leu Thr Ala Phe Leu Ile Ser Ser Arg Gln Val Glu Lys
1 5 10 15
Ala Phe Trp His Pro Asp Ala Pro Val
20 25

<210> 36
<211> 25
<212> PRT
<213> Escherichia coli

<400> 36
Tyr Cys Ala Leu Ser Ala Phe Leu Ile Ser Ser Arg Gln Val Glu Lys
1 5 10 15
Ala Ser Trp His Pro Asp Ala Pro Val
20 25

<210> 37
<211> 34
<212> PRT
<213> Homo sapiens

<400> 37
Tyr Gly Leu Val Ala Ala Ser Tyr Asp Gly Gly Leu Val Met Leu Asp
1 5 10 15
Val Val Pro Pro Phe Lys Val Arg Ala Ala Arg Gln Ala Ala Asp Phe
20 25 30
Ala Leu

<210> 38
<211> 31
<212> PRT
<213> Saccharomyces cerevisiae

<400> 38
Tyr Ser Met Val Cys Asp Thr Tyr Asp Ser Ser Met Leu Asp Trp Thr
 1   5   10   15
Ser Ile Thr Asn Val Asn Ala Arg Ala Val Cys Gly Phe Ala Val
            20   25   30

<210> 39
<211> 50
<212> PRT
<213> Nicotiana tabacum

<400> 39
Gly Val Glu Val Glu Thr Arg Thr Ile Glu Glu Val Arg Glu Val Leu
 1   5   10   15
Asp Tyr Ala Ser Gln Thr Lys Thr Ser Leu Thr Arg Ile Met Leu Asp
            20   25   30
Asn Met Val Val Pro Leu Ser Asn Gly Asp Ile Asp Val Ser Met Leu
        35   40   45
Lys Glu
    50

<210> 40
<211> 21
<212> PRT
<213> Rhodospirillum rubrum

<400> 40
Glu Ile Leu Gln Leu Ala Ala Val Gly Gly Ala Glu Val Val Leu Asp
 1   5   10   15
Ala Pro Thr Thr Arg
            20

<210> 41
<211> 25
<212> PRT
<213> Mycobacterium lepre

<400> 41
Glu Ser Leu Gln Leu Asp Ala Met Ala Glu Glu Pro Glu Leu Leu Phe
 1   5   10   15
Val Trp Gln Thr Gln Val Ala Val Gln
            20   25

<210> 42
<211> 21
<212> PRT
<213> Salmonella typhimurium

<400> 42
Glu Asn Leu Asp Glu Leu Asp Asp Ala Lys Gly Ala Asp Ile Phe Asn
 1   5   10   15
Thr Asp Gln Met Arg

20

<210> 43
<211> 18
<212> PRT
<213> Escherichia coli

<400> 43
Glu Asn Leu Leu Asp Ala Lys Gly Ala Asp Ile Phe Glu Thr Glu Gln
 1   5   10   15
Met Arg

<210> 44
<211> 28
<212> PRT
<213> Homo sapiens

<400> 44
Lys Cys Ser Ser Leu Gln Val Gln Ala Ala Glu Gly Ala Asp Leu Val
 1   5   10   15
Leu Phe Lys Pro Glu Glu Leu His Pro Thr Ala Thr
            20   25

<210> 45
<211> 26
<212> PRT
<213> Saccharomyces cerevisiae

<400> 45
Lys Ile Cys Leu Ser Glu Asp Ala Thr Ala Ile Glu Gly Ala Asp Val
 1   5   10   15
Phe Lys Gly Asp Gly Leu Lys Cys Ala Gln
            20   25

<210> 46
<211> 46
<212> PRT
<213> Nicotiana tabacum

<400> 46
Ala Val Glu Leu Ile Asn Gly Arg Phe Asp Thr Glu Ala Ser Gly Asn
 1   5   10   15
Val Thr Leu Glu Thr Val His Lys Ile Gly Gln Thr Gly Val Thr Tyr
            20   25   30
Ile Ser Ser Gly Ala Leu Thr His Ser Val Lys Ala Leu Asp
        35   40   45

<210> 47
<211> 20
<212> PRT
<213> Rhodospirillum rubrum

<400> 47
Asp Met Val Ala Leu Val Gly Ser Asp Ile Ala Ala Leu Ala Glu Ser
 1   5   10   15
Asp Val Thr Thr
            20

<210> 48
<211> 29
<212> PRT
<213> Mycobacterium lepre

<400> 48
Arg Arg Asp Ile Arg Ala Pro Thr Val Leu Leu Ser Gly Leu Ser Asn
 1   5   10   15
Ala Ala Ile Tyr Ala Gly Asp Tyr Leu Ala Val Arg Ile
            20   25

<210> 49
<211> 21
<212> PRT
<213> Salmonella typhimurium

<400> 49
Lys Arg Val Gln Ala Arg Leu Val Ala Glu Leu Arg Glu Phe Ala Glu
 1   5   10   15
Asp Phe Val Gly Arg
            20

<210> 50
<211> 20
<212> PRT
<213> Escherichia coli

<400> 50
Lys Arg Thr Lys Ala Leu Leu Val Asp Lys Leu Arg Glu Phe Ala Glu
 1   5   10   15
Asp Phe Val Gln
            20

<210> 51
<211> 33
<212> PRT
<213> Homo sapiens

<400> 51
Leu Lys Ala Gln Phe Pro Ser Val Ala Val Glu Ala Gly Ile Thr Asp
 1   5   10   15
Asn Leu Pro Gln Phe Cys Gly Pro His Ile Asp Val Met Met Gln Ala
            20   25   30
Pro

<210> 52
<211> 44
<212> PRT
<213> Saccharomyces cerevisiae

<400> 52
Ser Leu Lys Asn Lys Trp Asn Gly Lys Lys His Phe Leu Leu Glu Cys
 1   5   10   15
Gly Leu Asn Asp Asn Leu Glu Glu Tyr Leu Cys Asp Asp Ile Asp Ile
            20   25   30
Tyr Thr Ser Ser Ile His Gln Gly Thr Pro Val Ile
        35   40

<210> 53
<211> 20
<212> PRT
<213> Nicotiana tabacum

<400> 53
Ile Ser Lys Leu Ile Asp Thr Glu Leu Ala Leu Glu Val Gly Arg Arg
 1   5   10   15
Thr Lys Arg Ala
            20

<210> 54
<211> 12
<212> PRT
<213> Rhodospirillum rubrum

<400> 54
Gly Asp Val Val Ala Pro Pro Lys Ala Glu Arg Ala
 1   5   10

<210> 55
<211> 6
<212> PRT
<213> Salmonella typhimurium

<400> 55
Leu Ser Met Arg Phe Cys
 1   5

<210> 56
<211> 6
<212> PRT
<213> Escherichia coli

<400> 56
Leu Ser Met Arg Phe Arg
 1   5

<210> 57
<211> 11
<212> PRT
<213> Homo sapiens

<400> 57
Phe Leu Phe Lys Val Ala Pro Val Pro Ile His
 1   5   10

<210> 58
<211> 4
<212> PRT
<213> Saccharomyces cerevisiae

<400> 58
Phe Leu Ala His
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